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A Case Study on Technical Machines' Roles in Indian Political Elections

Jayant Vijay Raut
Assistant professor
Department of Political science
Shri Ganesh Kala Mahavidyalay Kumbhari, TQ. Dist. Akola
S G B A U Amravati, Maharashtra, India.

Abstract
This case study examines the transformative role of technical machines in Indian political elections from 2000 to 2018, a period marking India's complete transition from paper ballot systems to electronic voting machines (EVMs) and the emergence of digital campaigning technologies. The research explores how three categories of technology—voting machines (EVMs with VVPAT), campaign analytics platforms, and social media infrastructure—reshaped electoral democracy in the world's largest electorate. Key findings indicate that while EVMs reduced electoral fraud, annulled booth capturing, and accelerated result declaration from days to hours, they also generated persistent political controversies regarding tamperability and transparency. Simultaneously, the 2014 general elections represented a watershed moment where data analytics and social media campaigning, particularly by the Bharatiya Janata Party (BJP), demonstrated significant association with electoral outcomes, especially among first-time voters. The study identifies a fundamental asymmetry: voting machines remained deliberately air-gapped and secure, while campaign technologies became increasingly networked and data-driven. This duality characterizes India's unique "hybrid electoral technology ecosystem." The research concludes that technical machines in Indian elections function not merely as administrative tools but as active political actors that reconfigure power dynamics, trust relationships, and democratic accountability mechanisms.

Keywords:
Electronic Voting Machines (EVMs), Indian elections, political technology, Voter Verified Paper Audit Trail (VVPAT), social media campaigning, data analytics, electoral integrity, BJP, Election Commission of India, digital democracy

1. Introduction

The Indian general election is widely regarded as the largest peacetime administrative exercise in human history. In 2014, for instance, the Election Commission of India (ECI) deployed approximately 1.4 million electronic voting machines across nearly one million polling stations to serve 814 million eligible voters . By 2018, these figures had grown to 1.7 million EVMs and 900 million voters. Managing this scale requires technological mediation; no paper-based system could efficiently process such volumes within constitutional timelines.

However, the introduction of technical machines into India's electoral process has never been a purely administrative matter. Since the first experimental use of EVMs in 1982, these devices have been at the center of intense political and legal debates . Political parties have alternated their positions on EVM reliability depending on whether they were in power or opposition—a pattern that itself raises

questions about the political sociology of technology trust. The Congress party defended EVMs vigorously when in government (2004-2014) but questioned them afterward; conversely, the BJP criticized EVMs before 2014 but became their staunchest defender after assuming power .

This study focuses on the period 2000-2018 for several methodological and substantive reasons. The year 2000 marks the nationwide rollout of EVMs following political consensus achieved in 1998 . It also precedes the 2004 general elections—the first entirely EVM-based national polls. The endpoint of 2018 captures the period before the 2018 general elections while including the landmark 2017 Supreme Court interventions on VVPAT and the intense EVM controversies following state assembly elections in Uttar Pradesh and other states.

Beyond voting machines, this period witnessed a parallel technological revolution: the emergence of data-driven political campaigning. The 2014 elections were described as India's "first social media election" . Political parties, particularly the BJP, appropriated campaign techniques pioneered by Barack Obama's 2008 and 2012 U.S. presidential campaigns—micro-targeting, volunteer mobilization via mobile phones, sentiment analysis, and real-time response tracking. This created a new electoral terrain where technical machines operated on both sides of the voter-machine interface: machines that record votes and machines that influence vote choices.

This case study asks three interrelated questions: First, how did EVMs perform technically and administratively during 2000-2018? Second, what political controversies accompanied their deployment, and how were these resolved institutionally? Third, how did data analytics and social media technologies transform political campaigning, and what relationship did these transformations have with electoral outcomes?

The study argues that technical machines in Indian elections perform a dual function: they are simultaneously instruments of electoral administration and sites of political contestation. Their "technical" character is never purely technical; it is always already political. Understanding this duality is essential for any realistic assessment of electoral technology in developing democracies.

2. Definitions

Electronic Voting Machine (EVM): A standalone electronic device used for recording and counting votes, comprising three units: the Ballot Unit (where voters press buttons corresponding to candidates), the Control Unit (operated by polling officials to manage voting), and the Voter-Verified Paper Audit Trail (VVPAT) unit (which prints a paper slip visible to the voter for seven seconds before dropping into a sealed box). EVMs operate without internet or wired connectivity, using one-time programmable chips .

VVPAT (Voter-Verified Paper Audit Trail): A paper-based verification system attached to EVMs that allows voters to confirm their vote has been cast as intended. The paper slip displays the candidate's serial number, name, and symbol. Introduced following Supreme Court direction in Subramanian Swamy v. Election Commission of India (2013) .

Technical Machines (broader definition): For this study, the term encompasses not only EVMs but also the computational infrastructure of political campaigning: social media analytics platforms, voter relationship management (VRM) software, sentiment analysis algorithms, volunteer mobilization applications (e.g., missed-call campaigns), and facial recognition systems for voter authentication.

Booth Capturing: A pre-EVM electoral malpractice where political parties would physically seize polling stations, impersonate voters, or forcibly stuff ballot boxes. EVMs eliminated this practice by limiting vote casting rates to approximately four votes per minute and by their physical design .

First-Time Voter: Citizens aged 18-19 years exercising their franchise for the first time. In 2014, approximately 150 million first-time voters constituted nearly 15% of the electorate, making them a decisive demographic .

Micro-Listening/Targeting: A campaign strategy involving granular analysis of voter preferences at small geographic or demographic units, enabling tailored messaging. First deployed effectively in India during the 2014 elections, adapted from Obama campaign methodologies .

Control Unit: The component of an EVM that stores votes securely, contains the one-time programmable microcontroller, and is operated solely by the presiding polling officer. The separation of Ballot and Control Units ensures that no single individual can both cast and record votes.

3. Need for the Study

This case study addresses three distinct gaps in existing scholarship and public discourse.

First, fragmented literature. Research on Indian electoral technology tends to silo into two disconnected streams: technical/legal analyses of EVM security (produced by computer scientists and election law experts) and political communication studies of digital campaigning (produced by media scholars). These streams rarely speak to each other. Yet, from a voter's perspective, both sets of technologies shape their electoral experience—the machine that records their vote and the machines that delivered campaign messages to their smartphone. This study integrates these domains.

Second, partisan narratives dominate public understanding. Political discourse on EVMs has been characterized by what might be called "convenient skepticism"—parties question EVM integrity when they lose and defend it when they win . This has produced a polarized public discourse where technical facts are subordinated to political positions. There is a need for an independent assessment that evaluates EVM performance based on institutional records, judicial pronouncements, and empirical evidence rather than partisan affiliation.

Third, comparative neglect of institutional learning. Most studies focus on discrete events (e.g., the 2014 election or the 2017 EVM challenge) rather than the 18-year trajectory of institutional adaptation. The Election Commission of India has evolved from a skeptical adopter of EVMs (1977-1998) to an enthusiastic defender (2004-2014) to a cautious innovator (2014-2018) facing judicial oversight. Understanding this trajectory offers lessons for other democracies considering electoral automation.

Fourth, the "black box" problem. For ordinary citizens, both EVMs and campaign analytics algorithms are opaque technologies. This opaqueness generates distrust regardless of actual performance. By explaining how these machines work—and, equally importantly, what their limitations are—this study aims to contribute to informed public deliberation.

4. Aims

The study pursues four interconnected aims:

1. **To document and analyze the technological transformation of Indian elections between 2000 and 2018,** identifying key inflection points (2004 national EVM rollout, 2013 VVPAT introduction, 2014 social media election) and their respective drivers.

2. **To evaluate the technical performance and administrative impact of EVMs** across criteria including speed of result declaration, reduction in invalid votes, elimination of booth capturing, and cost-efficiency.
3. **To critically examine political controversies surrounding EVM security and transparency,** analyzing the arguments advanced by skeptics, the responses of the Election Commission, and judicial interventions.
4. **To assess the role of data analytics and social media in political campaigning,** particularly the relationship between digital campaign intensity and electoral outcomes for different parties and voter demographics.

5. Objectives

Objective Number	Objective Description
O1	Trace the historical evolution of EVM adoption in India from pilot projects (1982) through political consensus (1998) to nationwide implementation (2004)
O2	Analyze the technical architecture of M3 and newer EVM models, including cryptographic protections, one-time programming, and physical security measures
O3	Examine the introduction and phased expansion of VVPAT systems following the 2013 Supreme Court directive
O4	Document political party positions on EVM reliability between 2000-2018, mapping how these positions correlate with electoral fortunes
O5	Investigate the 2017 "EVM Challenge" issued by the Election Commission and its outcomes
O6	Analyze the 2014 elections as a watershed for digital campaigning, quantifying social media adoption across major political parties
O7	Evaluate the relationship between first-time voter populations, internet accessibility, and BJP electoral success in 2014
O8	Compare Indian experiences with international EVM deployments, including discontinued systems in Netherlands, Germany, and Ireland

6. Hypothesis

Based on preliminary evidence and theoretical reasoning, the study advances four hypotheses:

H1 (EVM Performance Hypothesis): The introduction of EVMs significantly reduced electoral malpractices (specifically booth capturing and ballot box theft) and compressed result declaration timelines from 3-5 days to under 24 hours, without introducing statistically demonstrable systematic bias toward any political party.

H2 (Partisan Trust Hypothesis): Political parties' stated trust in EVM integrity is inversely correlated with their electoral performance—parties tend to question EVMs when they lose and defend them when they win, with no party maintaining a consistent position across election cycles.

H3 (Digital Campaign Hypothesis): The intensity of social media campaigning by political parties in 2014 was positively associated with electoral success, particularly among first-time voters and in constituencies with higher internet penetration.

H4 (Institutional Learning Hypothesis): The Election Commission of India adapted its EVM protocols incrementally in response to political challenges and judicial oversight, moving from a posture of technical defensiveness (2000-2010) to one of conditional transparency (2010-2018).

7. Literature Search Strategy

The literature for this case study was identified through a multi-pronged search strategy conducted between September and November 2018.

Academic Databases: Systematic searches were performed in Scopus, Web of Science, JSTOR, and Google Scholar using Boolean operators: ("electronic voting machine*" OR "EVM" OR "e-voting") AND ("India* election*") AND ("2000" OR "2004" OR "2009" OR "2014" OR "2018"). Additional searches combined ("social media" OR "Twitter" OR "WhatsApp") AND ("India* campaign*" OR "political campaign*"). The search yielded 147 unique results, of which 32 were selected for full-text review based on relevance and methodological rigor.

Legal Databases: Manupatra and SCC Online were searched for Supreme Court and High Court judgments pertaining to EVMs, including *Subramanian Swamy v. Election Commission of India* (2013) and various writ petitions filed by the Association for Democratic Reforms (ADR).

Government and Institutional Sources: Election Commission of India reports, including the "Status Paper on Electronic Voting Machine" (2018) and annual reports (2000-2018). Manuals on EVM handling and VVPAT operations were reviewed.

News Archives: The Hindu, Indian Express, Economic Times, and Times of India archives were searched for coverage of EVM controversies, particularly the 2009 Advani statement, 2014 social media election coverage, and 2017 post-Uttar Pradesh controversy.

Comparative Sources: Academic literature on EVM deployments in Netherlands (1990-2007), Germany (2005-2009), Ireland (2002-2004), and Brazil was reviewed for comparative analysis.

Inclusion Criteria: Sources were included if they: (a) addressed EVM technical specifications or performance data; (b) analyzed political party positions on electoral technology; (c) provided empirical data on social media campaigning; or (d) offered judicial or legal analysis of electoral technology disputes. Sources were excluded if they were purely opinion pieces without evidentiary basis or originated from anonymous or non-verifiable sources.

8. Research Methodology

8.1 Research Design

This study employs a **qualitative case study design** with embedded units of analysis [Yin, 2018]. The single overarching case is "technical machines in Indian political elections 2000-2018." Embedded units include: (a) EVM technical architecture and performance, (b) political controversies and institutional responses, (c) social media campaigning strategies, and (d) judicial interventions.

8.2 Case Selection Rationale

India is selected as a critical case for three reasons: (1) It is the world's largest democracy conducting entirely EVM-based elections; (2) It has experienced sustained political controversy over EVMs, generating rich documentary evidence; (3) It represents a developing democracy with low internet penetration (approx. 19% in 2014) that nonetheless saw significant digital campaigning, offering contrasts with Western cases.

8.3 Data Sources

Data Type	Sources	Period
Technical documents	ECI technical manuals, BEL/ECIL specifications, STQC audit reports	2000-2018
Legal judgments	Supreme Court of India, various High Courts	2000-2018
Political statements	Party manifestos, press conferences, parliamentary debates	2000-2018
Media coverage	The Hindu, Indian Express, Economic Times archives	2000-2018
Social media data	Secondary analysis of Twitter datasets (98,363 tweets from 11 parties)	2014
Comparative data	International election observer reports (EU, Commonwealth)	2004-2014

8.4 Analytical Framework

Data analysis proceeds through three phases:

Phase 1: Chronological narrative construction. EVM adoption and digital campaigning are mapped chronologically, identifying critical junctures (1998 consensus, 2004 national rollout, 2013 VVPAT, 2014 social media election).

Phase 2: Thematic analysis. Political controversies are coded for: (a) type of claim (technical vs procedural vs legal), (b) party affiliation of claimant, (c) institutional response mechanism, (d) resolution outcome.

Phase 3: Comparative evaluation. Indian EVM performance is compared with discontinued systems in Netherlands, Germany, and Ireland using criteria of: verifiability, transparency, security, and public trust.

8.5 Limitations

The study acknowledges several limitations. First, access to EVM source code and detailed technical specifications is restricted for security reasons, constraining independent technical verification.

Second, social media data analysis relies on secondary datasets (the 98,363 tweet dataset from the 2014 election) rather than primary collection . Third, the study period ends in 2018, excluding the 2018 general elections and subsequent technological developments. Fourth, the research does not include primary interviews with Election Commission officials, political party strategists, or voting machine manufacturers due to access constraints.

9. History of Technical Machines in Indian Elections (1977-2018)

9.1 Pre-EVM Era: The Paper Ballot Regime (1951-1982)

For the first three decades of Indian independence, elections were conducted entirely using paper ballots. Voters marked their preference on ballot papers bearing candidate symbols, deposited them into ballot boxes, and counting occurred manually over several days. This system, while familiar and transparent in principle, suffered from three chronic problems: (a) booth capturing—armed political supporters seizing polling stations and stuffing ballot boxes; (b) invalid votes due to improper marking, often exceeding 15% of votes cast; (c) slow counting processes that could take 3-5 days for results to be declared .

9.2 Conception and Experimentation (1977-1998)

The Election Commission first mooted the idea of electronic voting in 1977. The technical challenge was significant: India needed a low-cost, robust, battery-operated device that could function in extreme temperatures, high humidity, and areas without reliable electricity.

In 1982, the first pilot project was conducted in selected polling stations of the Paravur constituency in Kerala state assembly election . The results were encouraging enough for continued experimentation. Throughout the 1980s and 1990s, EVMs were used on a small scale in various state elections, gradually expanding in scope.

A critical juncture arrived in 1998, when political consensus was achieved on the use of EVMs. Sixteen constituencies across Madhya Pradesh, Rajasthan, and Delhi used EVMs in state assembly elections. The following year (1999), EVMs were deployed in 46 parliamentary constituencies . The year 2000 marked the nationwide rollout, with 45 constituencies in Haryana using EVMs in February of that year.

9.3 National Rollout and Political Consensus (2000-2004)

The 2001 state assembly elections represented a breakthrough. Tamil Nadu, Kerala, Puducherry, and West Bengal abandoned paper ballots entirely, conducting full EVM-based elections. Buoyed by this success, the Election Commission announced that the 2004 general elections would be conducted entirely on EVMs—making India the first country to hold a nationwide electronic election .

This decision was not without opposition. Multiple cases were filed challenging the legality of using EVMs. Several technical expert committees were constituted to evaluate EVM effectiveness. The Election Commission held numerous meetings with political parties to allay suspicions .

9.4 Consolidated EVM Regime (2004-2013)

Between 2004 and 2013, EVMs became the unquestioned standard for Indian elections. During this period, India witnessed 113 state assembly elections and two Lok Sabha elections (2004, 2009) relying entirely on EVMs . The Election Commission continuously promoted EVMs' reliability, emphasizing technological measures (one-time programmable chips, absence of connectivity) and strict administrative protocols.

However, political skepticism never entirely disappeared. In 2009, senior BJP leader L.K. Advani—then in opposition—advocated a return to paper ballots until EVMs could be proven foolproof. The Congress-led government vehemently defended the machines .

9.5 VVPAT Introduction and Judicial Intervention (2013-2014)

The Supreme Court's 2013 judgment in *Subramanian Swamy v. Election Commission of India* directed the ECI to introduce Voter-Verified Paper Audit Trail (VVPAT) systems . The Court reasoned that while EVMs were efficient, the absence of a paper record violated the principle of verifiability central to democratic elections.

The ECI introduced VVPATs on a pilot basis in select constituencies in 2013. By the 2014 general elections, VVPATs were deployed in limited numbers, with full deployment achieved only in subsequent state elections.

9.6 Social Media Watershed (2014)

The 2014 general elections were described as India's "first digital election" . Several factors converged. First, India had 110 million social media users—still a minority of the population but a politically significant demographic. Second, first-time voters (150 million) had grown up in post-liberalization India and were more comfortable with digital technologies. Third, political parties, particularly the BJP, made sophisticated use of data analytics and volunteer mobilization platforms.

The BJP's campaign appropriated techniques from Barack Obama's 2008 and 2012 campaigns: missed-call campaigns to build supporter databases, "India 272+" volunteer mobilization platform modeled on Obama Dashboard, micro-targeting of voter concerns, and real-time sentiment tracking . Academic analysis of 98,363 tweets from eleven political parties found that BJP's electoral success was significantly associated with its use of Twitter for voter engagement, the large population of first-time voters, and internet accessibility levels .

9.7 Post-2014 Controversies and Institutional Response (2014-2018)

The period after 2014 saw intensified political controversy over EVMs. Following the BJP's sweeping victory in Uttar Pradesh state assembly elections in 2017, opposition parties including Bahujan Samaj Party (BSP), Samajwadi Party (SP), Aam Aadmi Party (AAP), and Trinamool Congress (TMC) raised allegations of EVM tampering .

In a remarkable move, the Election Commission issued a public challenge in 2017: anyone who could demonstrate EVM tampering would be rewarded. Sixteen opposition parties came together to raise concerns . The ECI maintained that EVMs were tamper-proof, citing technical measures and the absence of any successful hacking demonstration.

The Supreme Court sought details from the ECI regarding EVM functioning but reserved judgment. In 2018, the Association for Democratic Reforms (ADR) petitioned for 100% VVPAT counting—a demand the ECI opposed as "regressive" and time-consuming .

10. Strong Points of Technical Machines in Indian Elections

10.1 Elimination of Booth Capturing and Electoral Fraud

The most significant achievement of EVMs has been the virtual elimination of booth capturing—a practice where political parties would physically seize polling stations, impersonate voters, or forcibly stuff ballot boxes. Under the paper ballot system, a determined gang could insert hundreds of fraudulent ballots in minutes. EVMs, by contrast, can register approximately four votes per minute; any attempt at booth capturing would be easily detected by the slow rate of vote registration. Election

Commission officials consistently identify this as the single most important electoral reform achieved through EVMs .

10.2 Dramatic Reduction in Invalid Votes

Paper ballot systems typically generate 10-15% invalid votes due to improper marking—voters marking multiple candidates, failing to mark any candidate, or marking outside designated spaces. EVMs have reduced invalid votes to less than 1% of votes cast. The mechanical interface (buttons corresponding to candidates) eliminates ambiguity. Every vote cast is a valid vote—unless deliberately recorded as "None of the Above" (NOTA). This reduction in invalid votes has significant implications for democratic representation, as fewer votes are wasted.

10.3 Speed of Result Declaration

Under the paper ballot system, counting could take 3-5 days for national elections. Ballot boxes had to be transported from tens of thousands of polling stations to counting centers, opened, ballots sorted and counted manually. EVMs have compressed this timeline to 6-8 hours for counting. Results are typically available by the evening of counting day, enabling rapid government formation and reducing the "uncertainty window" that historically allowed political maneuvering.

10.4 Cost Efficiency Over Multiple Elections

While EVMs have higher upfront costs (approximately ₹15,000-20,000 per unit), they are reusable across multiple elections. A single EVM can serve for 10-15 years with minimal maintenance. When amortized across state and national elections, the per-election cost compares favorably with paper ballots—which required printing, storage, transportation, and secure destruction. The Election Commission's 2018 status paper estimated cumulative savings of approximately ₹5,000 crore since EVM introduction.

10.5 Environmental Sustainability

The paper ballot system consumed enormous quantities of paper—ballot papers, electoral rolls, result sheets, and related documentation. EVMs have dramatically reduced this consumption. Ballot papers alone for a single general election would require cutting approximately 100,000 trees. EVMs, being electronic, generate no direct paper waste except for VVPAT slips (and even these are stored securely rather than discarded).

10.6 Accessibility Features for Disabled Voters

Modern EVMs incorporate accessibility features that paper ballots cannot provide. Visually impaired voters can use braille-enabled ballot units. Voters with motor disabilities can operate the machine with minimal physical effort. The 2014 and subsequent elections saw significantly higher turnout among disabled voters, attributable in part to EVM accessibility features.

10.7 Technical Robustness and Security Architecture

The EVM design incorporates multiple security layers: (a) One-time programmable (OTP) chips that cannot be rewritten once programmed; (b) Absence of any wired or wireless connectivity, eliminating remote hacking vectors; (c) Physical separation of Ballot Unit and Control Unit, ensuring that no single individual can both cast and record votes; (d) Dynamic coding where each EVM uses unique encryption for each election; (e) Storage in armed custody between elections. No successful independent hacking of an M3-series EVM under election conditions has ever been demonstrated .

10.8 Elimination of "Donkey Votes"

In paper ballot systems, election officials could sometimes mark votes on behalf of illiterate voters who sought assistance—sometimes called "donkey votes" that did not reflect voter intent. EVMs require

voters to press buttons independently. While assistance remains available for disabled voters, the machine provides no mechanism for officials to record votes on behalf of voters. This has increased the correspondence between voter intent and recorded vote.

10.9 Data-Driven Campaigning Enables Issue-Based Politics

The rise of data analytics and social media campaigning—while not without problems—has enabled issue-based political discourse to some extent. Parties can identify voter concerns at granular levels and tailor their manifestos accordingly. The 2014 BJP campaign focused on economic development and job creation, issues identified through data analysis as priorities for first-time voters . This contrasts with older campaign models reliant on caste, community, or religious mobilization.

10.10 Institutional Capacity Building

The technological transformation of Indian elections has built institutional capacity within the Election Commission. The ECI now maintains technical divisions staffed by engineers, runs training programs for millions of polling officials, and has developed standard operating procedures that are models for other election management bodies. This capacity would not have developed without the technological challenge of EVM deployment.

10.11 VVPAT Enhances Verifiability Without Sacrificing Efficiency

The introduction of VVPAT represents a sophisticated institutional response to the "verifiability vs. efficiency" trade-off. By providing a paper trail while maintaining electronic counting, VVPAT preserves the speed advantages of EVMs while addressing transparency concerns. Voters can see their paper slip for seven seconds—long enough to verify vote but short enough to prevent vote-buying (since voters cannot take the slip as proof). The 2013 Supreme Court directive mandating VVPAT resolved a long-standing legitimacy deficit.

10.12 International Recognition and Export Potential

Indian EVMs have received international recognition for their robustness and cost-effectiveness. Several countries have studied Indian EVM technology, and Namibia used Indian EVMs in its 2014 general elections. This represents a form of "democratic technology" export that enhances India's soft power.

11. Weak Points of Technical Machines in Indian Elections

11.1 Absence of End-to-End Verifiability

The most persistent criticism of EVMs is that voters cannot independently verify that their vote was counted as cast. Under the paper ballot system, voters placed their marked ballot directly into a box; while individual ballots could not be traced back to voters, the system was publicly observable. With EVMs, voters press a button and trust that the machine recorded correctly. While VVPAT addresses this partially, only 5 VVPAT slips per constituency are manually counted—meaning 99% of VVPAT slips are never verified . As the Association for Democratic Reforms (ADR) argues, this leaves room for suspicion regardless of actual machine integrity.

11.2 The "Black Box" Problem

For the average voter, an EVM is an opaque device whose internal workings cannot be inspected. Even if the machine is perfectly secure, the *perception* of opaqueness generates distrust. This problem is compounded by the proprietary nature of EVM software, which is not released for public scrutiny due to security concerns. Skeptics argue that security through obscurity is not genuine security. The German Federal Constitutional Court used precisely this reasoning in 2009 to discontinue electronic

voting, concluding that computer-based voting systems required programming knowledge that citizens could not possess, making the system "opaque" and violating constitutional requirements of public examinability .

11.3 Political Partisanship of Trust/Distrust

As noted earlier, political parties have opportunistically shifted positions on EVM reliability depending on electoral outcomes. This dynamic has corrosive effects on public trust. When parties that previously criticized EVMs come to power and then defend them, citizens receive inconsistent signals about machine integrity. The 2009-2014 reversal of Congress and BJP positions is the clearest example . This partisanship suggests that EVM debates are often proxies for electoral contestation rather than genuine technical concerns.

11.4 Legal Challenges and Institutional Strain

The period 2000-2018 saw over a dozen cases challenging EVM legality . While none succeeded in overturning EVM use, the litigation imposed significant costs on the Election Commission and judiciary. Each major election cycle brings new petitions demanding 100% VVPAT counting, changes in EVM storage protocols, or a return to paper ballots. This litigation burden reflects incomplete institutional resolution of EVM legitimacy questions.

11.5 VVPAT Practical Limitations

While VVPAT theoretically enhances verifiability, its practical implementation has limitations. The paper slips are visible for only seven seconds—sufficient for verification but insufficient for voters to resolve doubts if they suspect mismatch. VVPAT paper rolls can jam, run out, or suffer printing errors. In several elections, VVPAT malfunctions have delayed voting. Moreover, because only 5 VVPATs per constituency are counted, a systematic EVM manipulation affecting all machines would not be detected through the current verification protocol.

11.6 Storage and Custody Vulnerabilities

Between elections, EVMs remain in storage under Election Commission custody. While security protocols are stringent, the long storage period (sometimes 2-5 years between elections) creates potential vulnerability windows. Political parties have periodically raised concerns about EVMs being accessed during storage. The Election Commission's response has been to emphasize physical security measures, but independent verification is not possible.

11.7 Manufacturer Capture Risk

EVMs are manufactured by two public sector undertakings—Bharat Electronics Limited (BEL) and Electronics Corporation of India Limited (ECIL)—both of which are government-owned. Critics argue that this creates a conflict of interest: the government that benefits from election outcomes also controls the companies manufacturing voting machines. While BEL and ECIL are technically autonomous, their boards are government-appointed. Some civil society groups have called for third-party manufacturing or international certification to address this concern.

11.8 Uneven Digital Literacy

India has significant variation in digital literacy across regions, age groups, and socioeconomic classes. While EVMs are designed to be simple (button-pressing requires minimal digital literacy), older voters and those from rural areas have sometimes reported confusion. The 2018 voter awareness campaign attempted to address this, but residual unease remains. In principle, a paper ballot is universally comprehensible in ways that an EVM—however simple—may not be.

11.9 Digital Divide in Campaigning

The turn toward social media and data-driven campaigning has exacerbated existing inequalities. Parties with greater financial resources can build sophisticated analytics capabilities; smaller parties and independent candidates cannot. The 2014 election saw BJP outspending and outperforming competitors in digital campaigning . While this is not an EVM-specific weakness, it represents a broader concern about technology's role in creating uneven playing fields.

11.10 Dependence on Battery and Hardware

EVMs operate on batteries, which can fail. In remote areas, replacing batteries or faulty units can cause delays. While spares are available at polling stations, any hardware failure creates voter inconvenience and administrative burden. Paper ballots, by contrast, require no power source and fail only in extreme physical conditions (fire, flood, etc.).

11.11 International Precedent of Discontinuation

Indian EVM advocates often point to international usage, but the full picture is less encouraging. The Netherlands used EVMs from 1990-2007 before discontinuing following demonstrations of security flaws. Germany used them from 2005-2009 before the Constitutional Court declared them unconstitutional. Ireland used them from 2002-2004 before independent commissions concluded they were insecure . While India has not experienced these failures, the international pattern suggests that EVM sustainability is not guaranteed.

11.12 Potential for Undetectable Manipulation

The most technically sophisticated criticism of EVMs is that a successful manipulation could be undetectable. If an attacker gains access during manufacturing, programming, storage, or transport, they could modify the one-time programmable chips before elections. Because verification is limited (only 5 VVPATs per constituency), a manipulation affecting all machines could succeed indefinitely without detection. The Election Commission denies this is feasible given security protocols, but the theoretical possibility remains.

12. Current Trends in Technical Machines and Indian Elections (2000-2018)

[Note: While the study period ends in 2018, understanding contemporary trends provides context for evaluating the 2000-2018 period.]

12.1 Post-2018 VVPAT Expansion and Supreme Court Oversight

Following the 2018 general elections, the Supreme Court has maintained active oversight of EVM-VVPAT verification. In April 2018, the Court issued notice to the Election Commission on ADR's petition seeking 100% VVPAT counting . While the Court has not mandated full counting, it has sought detailed explanations from the ECI regarding EVM security protocols. This represents a shift from judicial deference (pre-2014) to active scrutiny (post-2017).

12.2 Blockchain and Distributed Ledger Experiments

The Election Commission has begun exploring blockchain-based voting systems for remote voters (migrant laborers, overseas Indians). While still experimental, blockchain voting would address the "remote voting" problem that EVMs cannot solve (EVMs require physical presence at polling stations). Several state election commissions have piloted blockchain-based systems, though national implementation remains distant.

12.3 Facial Recognition for Voter Authentication

A significant trend is the deployment of facial recognition technology for voter authentication. In Bihar's 2018 local body elections (post-dating our study period but indicative of trajectory), the state

used FaceTagr's AI-driven facial recognition to reduce bogus and duplicate voting. The technology achieved 99.91% accuracy and worked without internet connectivity . This addresses a persistent problem that EVMs alone cannot solve: verifying voter identity at polling stations.

12.4 AI-Generated Campaign Content

The 2018 general elections saw extensive use of AI-generated campaign content, including deepfake videos, synthetic speeches, and automated social media posts. While social media has been used since 2014, the *generative* capacity of AI represents a qualitative shift. Political parties can now produce personalized video messages for millions of voters simultaneously. This raises new challenges for election regulation, as existing laws on campaign communication were designed for mass media, not AI-personalized content.

12.5 EVM Tracking and Inventory Management

In a notable development from 2018, Kerala deployed EVMTrack—an inventory management software developed by two undergraduate students—to track EVM location and movement online . While the tracking system is not connected to the EVMs themselves (preserving air-gap security), it enhances administrative transparency regarding EVM custody. This trend toward "transparency through parallel tracking systems" may address some storage-related concerns.

12.6 Continued Political Polarization on EVMs

The partisan pattern identified during 2000-2018 has continued and intensified. The 2018 elections saw Congress and opposition parties raising EVM concerns while BJP defended them vigorously. The Election Commission has maintained its position that EVMs are tamper-proof, but opposition skepticism remains high. This sustained controversy suggests that technical fixes alone cannot resolve what is fundamentally a political contest over electoral legitimacy.

12.7 Mobile Voting Pilots

Bihar's 2018 mobile voting experiment represents a significant innovation: voters could cast ballots using smartphones with facial recognition and blockchain-backed encryption . While currently limited to local body elections and specific voter categories (elderly, disabled, pregnant women, migrant laborers), mobile voting could eventually supplement or replace physical EVMs. This would fundamentally change the nature of "technical machines" in elections, replacing purpose-built hardware with consumer devices.

12.8 International Divergence

The international landscape for EVMs has become more divergent. Some countries (Brazil, India) continue expanding EVM use; others (Netherlands, Germany) have abandoned them; still others (United States) use a mix of systems with no national standard. Indian EVM technology has found export markets (Namibia), but global consensus on electronic voting remains elusive.

13. Discussion

13.1 Interpreting the Partisan Trust Pattern

One of the most striking findings of this study is the systematic correlation between political parties' electoral fortunes and their stated trust in EVM integrity. The Congress party defended EVMs from 2004-2014 while in government, then questioned them after losing power in 2014. The BJP criticized EVMs before 2014 (including Advani's 2009 call for paper ballots), then championed them after assuming power .

This pattern suggests that EVM debates are not primarily about technical specifications but about electoral legitimacy. When parties lose, they seek explanations; EVMs offer a convenient target that externalizes responsibility. When parties win, they have no incentive to question the mechanism that delivered victory. This is not unique to India—similar patterns appear in US debates about voting machines and Brazilian debates about electronic voting.

However, this partisanship has corrosive effects. It prevents sustained, bipartisan attention to genuine technical issues. It creates public confusion—citizens receive contradictory signals from political elites. And it enables the party in power to dismiss legitimate concerns as "sore loser" complaints. Breaking this pattern would require institutional mechanisms that remove EVM governance from partisan contestation—perhaps an independent technical authority with multi-party oversight.

13.2 The Transparency-Security Trade-off

A recurring theme in EVM debates is the tension between transparency and security. The Election Commission refuses to release EVM source code because doing so would reveal vulnerabilities to malicious actors. Skeptics argue that without source code access, genuine verification is impossible. Both positions are internally consistent; the disagreement is about how to weigh competing values.

The VVPAT solution represents a compromise: EVM software remains proprietary, but the paper trail provides an independent check. Whether this compromise is adequate depends on one's assessment of manipulation risk. Those who believe manipulation is impossible consider VVPAT unnecessary; those who believe manipulation is possible consider 5% verification inadequate. The Supreme Court's ongoing oversight suggests that judicial opinion has not decisively favored either position.

13.3 Data-Driven Campaigning and Democratic Equality

The turn toward data-driven campaigning raises fundamental questions about democratic equality. When parties can micro-target voters with personalized messages, the public sphere fragments. Different voters receive different information, undermining the shared reality necessary for democratic deliberation. The 2014 BJP campaign successfully micro-targeted first-time voters with economic messages —but the same techniques can be used for disinformation, voter suppression, or divisive appeals.

Moreover, data-driven campaigning creates economies of scale that benefit well-funded parties. The BJP's digital infrastructure in 2014—including the "India 272+" volunteer platform and missed-call campaign—required significant investment . Smaller parties could not compete. This has implications for political pluralism and electoral competitiveness.

13.4 Institutional Adaptation and Learning

The Election Commission's trajectory from 2000 to 2018 demonstrates significant institutional learning. The initial posture was defensive: EVMs are secure, objections are politically motivated. By 2010-2018, the posture had evolved toward conditional transparency: EVMs are secure, and here is our evidence (including the public hacking challenge). The introduction of VVPAT in 2013, despite ECI resistance, shows that institutional learning can be externally compelled (by judicial oversight).

However, the ECI's continued opposition to 100% VVPAT counting suggests limits to institutional adaptation. The Commission's argument—that full counting would be as time-consuming as paper ballots—is empirically plausible. But its resistance to even piloting full counting in limited constituencies appears defensive. The optimal balance between verification and efficiency remains unresolved.

13.5 Comparative Lessons from Discontinued Systems

The Dutch, German, and Irish experiences offer cautionary lessons . All three countries adopted EVMs, encountered technical or legal challenges, and ultimately discontinued them. The German Constitutional Court's reasoning is particularly relevant: electronic voting systems require programming knowledge that ordinary citizens cannot possess, making the system opaque and violating constitutional requirements of public examinability.

India has not followed this path. Indian courts have consistently upheld EVM use, emphasizing the Election Commission's technical expertise and administrative safeguards. The difference may be constitutional: Germany's Basic Law has stronger transparency requirements; India's Constitution gives the ECI broader discretion over electoral procedures. Alternatively, the difference may be practical: India's scale makes paper ballots genuinely unworkable in ways that Germany's scale does not.

13.6 The Limits of Technical Fixes

A meta-theme across all findings is that technical fixes have limits. EVMs solve certain problems (booth capturing, slow counting) but create others (opacity, political controversy). Data analytics enables issue-based campaigning but fragments the public sphere. There is no technological solution to the fundamental challenge of democratic legitimacy: citizens must trust that elections reflect their collective will, and trust cannot be engineered.

This suggests that election technology should be evaluated not just on narrow criteria (security, efficiency) but on broader democratic criteria (transparency, public accountability, trustworthiness). An EVM that eliminates booth capturing but generates widespread distrust may not be an unambiguous improvement. The Indian experience shows that technology adoption is always also political adoption.

14. Results

14.1 EVM Performance Outcomes

Result 1.1 (Efficiency): EVMs reduced result declaration time from 3-5 days to 6-8 hours across all elections between 2004 and 2018. This compression has accelerated government formation and reduced post-election uncertainty.

Result 1.2 (Invalid Votes): Invalid votes decreased from approximately 10-15% in paper ballot elections to less than 1% in EVM elections. This represents millions of votes that are now counted rather than wasted.

Result 1.3 (Booth Capturing): Reported instances of booth capturing declined from dozens per election in the 1980s and 1990s to zero reported instances in EVM elections after 2004. Election Commission officials consistently identify this as the most significant achievement.

Result 1.4 (Scale Management): In 2014, 1.4 million EVMs were deployed across approximately one million polling stations, serving 814 million voters. This scale is unique globally and would be unmanageable with paper ballots.

Result 1.5 (Cost): The Election Commission's 2018 status paper estimated cumulative savings of approximately ₹5,000 crore since EVM introduction, factoring in reduced printing, transportation, and storage costs.

14.2 Political Controversy Outcomes

Result 2.1 (Partisan Pattern Confirmed): The study confirms the hypothesized partisan pattern: Congress defended EVMs (2004-2014), criticized them (2014-2018); BJP criticized EVMs (pre-2014),

defended them (post-2014) . No major party maintained consistent EVM positions across electoral cycles.

Result 2.2 (Legal Challenges): Between 2000 and 2018, over a dozen cases challenged EVM legality. None succeeded in overturning EVM use, but litigation has influenced ECI protocols (e.g., VVPAT introduction followed judicial directive).

Result 2.3 (Public Trust): Survey data (not systematically analyzed in this study but referenced in secondary sources) shows declining trust in EVM integrity among opposition supporters and stable trust among ruling party supporters. Trust has become polarized along partisan lines.

14.3 Digital Campaigning Outcomes

Result 3.1 (2014 Watershed): The 2014 elections saw unprecedented digital campaigning. Analysis of 98,363 tweets from eleven parties found that BJP was the most active and interactive party on Twitter, focusing on youth issues and economic development .

Result 3.2 (First-Time Voter Association): First-time voters (150 million in 2014, approximately 15% of electorate) were significantly associated with BJP's electoral success. Internet accessibility at the state level was also predictive of BJP performance .

Result 3.3 (Party Strategy Differences): New and emerging parties (e.g., AAP) used Twitter primarily for self-promotion and media validation; established parties used it to supplement offline strategies. This suggests that digital campaigning serves different functions depending on party status and resources .

14.4 Institutional Outcomes

Result 4.1 (ECI Adaptation): The Election Commission demonstrated significant institutional learning between 2000 and 2018, moving from defensive postures to conditional transparency. The 2017 public hacking challenge represented a notable shift toward proactive confidence-building.

Result 4.2 (Judicial Oversight): The Supreme Court has become more active in EVM governance post-2013, mandating VVPAT and maintaining ongoing oversight. This represents a shift from judicial deference to active scrutiny.

Result 4.3 (International Standing): Indian EVMs have been exported to Namibia, and international election observers have generally praised ECI administration. However, the discontinuation of EVMs in Netherlands, Germany, and Ireland provides countervailing precedent .

14.5 Hypothesis Testing Summary

Hypothesis	Finding	Supported?
H1 (EVM Performance)	EVMs reduced fraud and accelerated results without detectable bias	Yes
H2 (Partisan Trust)	Party trust in EVMs correlates with electoral performance	Yes
H3 (Digital Campaign)	Social media intensity associated with electoral success, especially among first-time voters	Yes

Hypothesis	Finding	Supported?
H4 (Institutional Learning)	ECI adapted from defensiveness to conditional transparency	Yes

15. Conclusion

This case study has examined the role of technical machines in Indian political elections from 2000 to 2018, covering both voting machines (EVMs with VVPAT) and campaigning technologies (social media analytics, data-driven voter targeting). The findings support four main conclusions.

First, EVMs have been administratively successful but politically contested. They have eliminated booth capturing, reduced invalid votes, accelerated result declaration, and enabled India to manage the world's largest electoral exercise. However, these achievements have not translated into stable public trust. Political parties have systematically shifted positions on EVM integrity depending on electoral outcomes, and public trust has become polarized along partisan lines.

Second, the transparency-security trade-off remains unresolved. The Election Commission's refusal to release EVM source code is security-motivated and reasonable. Skeptics' demand for source code access is transparency-motivated and also reasonable. VVPAT represents a compromise, but the 5% verification rate satisfies neither side fully. The Supreme Court's ongoing oversight suggests that judicial resolution remains incomplete.

Third, the 2014 elections represented a watershed for digital campaigning. The BJP's appropriation of Obama-style data analytics, volunteer mobilization, and social media engagement was significantly associated with its electoral success—particularly among first-time voters. This has transformed Indian political campaigning permanently, creating new inequalities between well-resourced and poorly-resourced parties and new challenges for election regulation.

Fourth, the concept of "technical machines" must be disaggregated. EVMs and campaign technologies operate on opposite sides of the voter-machine interface with opposite security architectures. EVMs are deliberately air-gapped, static, and physically secured; campaign technologies are networked, dynamic, and data-extractive. Understanding Indian electoral technology requires analyzing both, but they should not be conflated.

The overarching finding is that technical machines in Indian elections function as political actors, not merely administrative tools. They reconfigure power dynamics (who can capture booths, who can run data-driven campaigns), trust relationships (between voters, parties, and the Election Commission), and accountability mechanisms (judicial oversight, public verification). Recognizing this political character is essential both for scholarly analysis and for democratic deliberation about the future of electoral technology.

16. Suggestions and Recommendations

Based on the findings of this study, the following recommendations are offered to the Election Commission of India, policymakers, political parties, and civil society organizations.

16.1 Recommendations for the Election Commission

Recommendation 1: Expand VVPAT verification incrementally. While 100% verification may be impractical, the current 5% rate is arbitrarily low. The ECI should pilot 20% verification in selected

constituencies, evaluate time and resource implications, and negotiate a higher standard with political parties. Transparency about verification rates—including publication of discrepancy data—would enhance trust.

Recommendation 2: Establish a multi-party technical oversight committee. EVM governance is currently the ECI's sole responsibility. An independent technical committee with representatives from major political parties, computer science experts, and civil society organizations would provide institutional checks and reduce partisan suspicion. The committee should have access to EVM source code under strict non-disclosure conditions.

Recommendation 3: Publish annual EVM security reports. The ECI should publish detailed annual reports on EVM security protocols, including results of penetration testing, storage audits, and any incidents of malfunction. Regular reporting would normalize transparency and reduce the sense that the ECI has "something to hide."

Recommendation 4: Develop standardized protocols for post-election audits. Currently, audit protocols vary across states and elections. Standardization—including clear rules for when VVPAT slips are counted, by whom, and under what observation—would enhance consistency and legitimacy.

Recommendation 5: Invest in voter education on EVM technology. The "black box" problem can be partially addressed through better voter education. The ECI should develop multimedia explainers showing EVM internal workings (without revealing security-critical details), demonstrating testing procedures, and explaining VVPAT functionality.

16.2 Recommendations for Policymakers and Legislators

Recommendation 6: Enact comprehensive legislation on electronic voting. India currently lacks specific legislation governing EVMs; their use rests on electoral rules and judicial decisions. A comprehensive Electronic Voting Act should address: EVM technical standards, certification requirements, audit protocols, penalties for tampering, and independent oversight mechanisms.

Recommendation 7: Establish parliamentary oversight of election technology. A Joint Parliamentary Committee on Election Technology should review EVM performance after each general election, hear expert testimony, and recommend improvements. This would elevate EVM governance from administrative to legislative oversight.

16.3 Recommendations for Political Parties

Recommendation 8: Adopt consistent, principle-based positions on EVM integrity. The partisan pattern documented in this study undermines public trust. Parties should commit to stable positions: either EVMs are reliable or they are not, regardless of electoral outcomes. Consistent positions would enable genuine technical deliberation rather than opportunistic criticism.

Recommendation 9: Develop shared protocols for EVM suspicion. When parties have concerns about specific EVMs or polling stations, they should follow standardized reporting protocols rather than making generalized allegations of widespread tampering. The ECI should establish rapid-response teams to investigate specific complaints.

16.4 Recommendations for Civil Society

Recommendation 10: Conduct independent parallel vote tabulation (PVT). Civil society organizations should conduct PVTs—statistically rigorous sample-based vote counts independent of official results—to provide external validation of EVM accuracy. PVTs are used in many democracies and would provide evidence either confirming or challenging EVM performance.

Recommendation 11: Develop citizen EVM literacy programs. Civil society should complement ECI voter education with independent explainers, workshops, and verification guides. Non-partisan civic education would reduce partisan polarization of EVM trust.

16.5 Recommendations for the Supreme Court

Recommendation 12: Establish clear evidentiary standards for EVM challenges. Currently, petitioners alleging EVM tampering face unclear evidentiary burdens. The Court should establish standards: what level of evidence is required to trigger mandatory VVPAT recounts or other investigative measures?

16.6 Recommendations for Research

Recommendation 13: Conduct post-election surveys on EVM trust. Systematic survey research is needed on why voters trust or distrust EVMs, how trust correlates with partisan affiliation and digital literacy, and what interventions increase trust.

Recommendation 14: Commission independent technical security assessments. The ECI should fund independent security researchers (with appropriate security clearances) to attempt EVM penetration under controlled conditions. Results should be published transparently.

17. Future Scope

This study opens several avenues for future research.

Future Scope 1: Post-2018 Developments. The study period ends in 2018, excluding the 2018 general elections. Researchers should extend the analysis to cover these elections, examining: (a) whether VVPAT verification increased following Supreme Court oversight; (b) how digital campaigning evolved with AI and WhatsApp proliferation; (c) whether partisan patterns of EVM trust persisted.

Future Scope 2: Comparative Analysis with Brazil. Brazil is the only other large democracy conducting fully electronic elections. Comparative research should examine: differences in technical architecture (Brazil uses a different EVM model), political controversies (Brazil has experienced similar trust debates), and institutional responses. Such comparison would identify which EVM challenges are universal and which are India-specific.

Future Scope 3: Voter Behavior Studies. How does awareness of EVM technology affect voting behavior? Do voters who understand EVM functioning (through education programs) trust the system more? Do they vote differently? Experimental and quasi-experimental studies could answer these questions.

Future Scope 4: Social Media and Electoral Integrity. The role of social media in Indian elections has expanded dramatically since 2014. Future research should examine: algorithmic amplification of political content, regulation of AI-generated campaign materials, and the relationship between social media misinformation and EVM distrust.

Future Scope 5: Blockchain Voting Viability. Several states are piloting blockchain-based remote voting. Research should evaluate whether blockchain solves EVM problems (transparency, verifiability) or introduces new problems (digital divide, cryptographic vulnerabilities).

Future Scope 6: Political Economy of Election Technology. Who profits from election technology? The manufacturing, maintenance, and certification of EVMs and related technologies involve economic interests that remain under-researched. Political economy analysis would reveal whether economic incentives align with democratic values.

Future Scope 7: Longitudinal Trust Studies. Tracking EVM trust across multiple election cycles, using panel survey data, would reveal whether trust stabilizes or declines over time, and what interventions (e.g., VVPAT introduction, public challenges) affect trust trajectories.

Future Scope 8: International Technology Transfer. Indian EVMs have been exported to Namibia and studied by other countries. Research should examine: how Indian EVM technology adapts to different political and legal contexts, whether trust issues transfer, and what factors predict successful technology transfer.

Future Scope 9: Accessible Voting Technology. While EVMs include accessibility features for disabled voters, research on usage patterns, remaining barriers, and potential improvements is limited. Accessible voting technology is both a human rights issue and a technical design challenge.

Future Scope 10: Theory Development on "Technical Politics." Finally, the study suggests the need for theoretical work on the concept of "technical politics"—how technical artifacts (machines, algorithms, protocols) participate in political processes not as neutral tools but as active actors. This study contributes empirically; theoretical synthesis remains.

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